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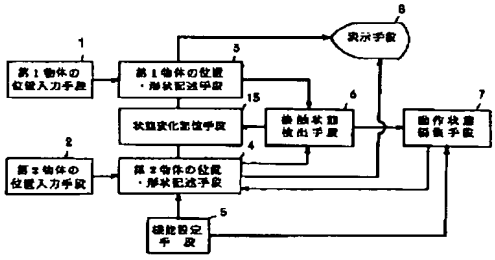
(54) OPERABILITY EVALUATION DEVICE

(57) Abstract:

PURPOSE: To constitute an operability evaluation device provided with improved characteristics capable of evaluating operability by solving a problem that a trial piece is to be prepared so as to evaluate the operability of a product, preparing only a shape model and virtually performing an operation relating to the operability evaluation device used in product design.

CONSTITUTION: An object 2 on a display means 8 for which buttons are arranged by using a function setting means 5 is moved with a position input means 2 for second object of the object 2 in the shape of the object 2. Button operations or the like are virtually performed to the object 2 with a position input means 1 of a first object fitted to the finger, states corresponding to the operations are displayed at the display means 8 and the state change of the respective objects is stored in a state change storage means 15. Thus, the operation performed once is utilized and the operability is efficiently evaluated.



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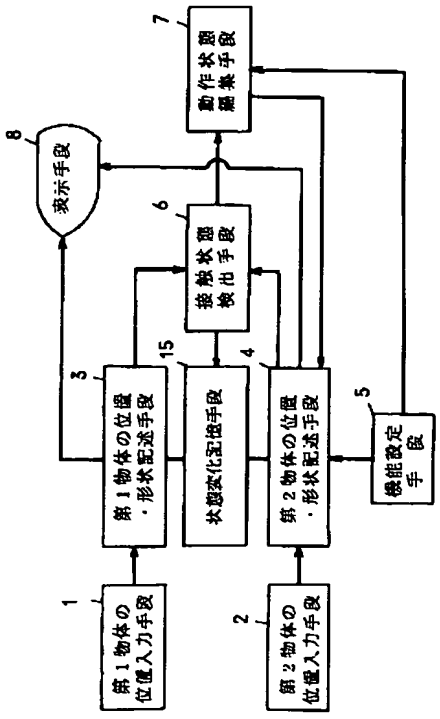
(54)【発明の名称】　操作性評価装置

(57)【要約】

【目的】　商品設計において使用される操作性評価装置に関するもので、商品の操作性を評価するために試作品を作らなければならないという問題を解決し、形状模型のみを作成し操作を仮想的に行なうことにより操作性を評価できるという優れた特性を持つ操作性評価装置を構成することを目的とする。

【構成】　機能設定手段５を用いてボタンを配置した表示手段８上の物体２を、物体２の形状を型どった物体２の第２物体の位置入力手段２によって動かし、手指に装着した第１物体の位置入力手段１によって物体２に対して仮想的にボタン操作等を行ない、操作に対応する状態を表示手段８に表示するとともに、状態変化記憶手段１５に各物体の状態変化を記憶をすることによって、一度行った操作を活用し効率よく操作性を評価することができる。



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【特許請求の範囲】

【請求項１】　物体の仮想的状態を表す立体図形を画面上に表示する操作性評価装置において、第１の物体の３次元空間における位置を入力する第１の位置入力手段と、該位置に対応する第１の物体の表わす立体図形データを作成する第１の位置・形状記述手段と、第２の物体の３次元空間における位置を入力する第２の位置入力手段と、該位置に対応する第２の物体の表わす立体図形データを作成する第２の位置・形状記述手段と、第２の物体の表わす立体図形の機能状態を設定する機能設定手段と、前記第１の物体の表わす立体図形と第２の物体の表わす立体図形との干渉を検出する検出手段と、該検出手段が前記干渉を検出したとき、前記第２の物体の表わす立体図形の機能状態を表示するための制御を行う動作状態編集手段と、第１の位置・形状記述手段と第２の位置・形状記述手段における立体図形データの状態変化を記憶する状態変化記憶手段を備えたことを特徴とする操作性評価装置。

【請求項２】　物体の仮想的状態を表す立体図形を画面上に表示する操作性評価装置において、第１の物体の３次元空間における位置を入力する第１の位置入力手段と、該位置に対応する第１の物体の表わす立体図形データを作成する第１の位置・形状記述手段と、第２の物体の３次元空間における位置を入力する第２の位置入力手段と、該位置に対応する第２の物体の表わす立体図形データを作成する第２の位置・形状記述手段と、第２の物体の表わす立体図形の機能状態を設定する機能設定手段と、前記第１の物体の表わす立体図形と第２の物体の表わす立体図形との干渉を検出する検出手段と、該検出手段が前記干渉を検出したとき、前記第２の物体の表わす立体図形の機能状態を表示するための制御を行う動作状態編集手段と、検出手段によって検出された検出結果に基づき触感を生成する触感覚生成手段を備えたことを特徴とする操作性評価装置。

【請求項３】　物体の仮想的状態を表す立体図形を画面上に表示する操作性評価装置において、第１の物体の３次元空間における位置を入力する第１の位置入力手段と、該位置に対応する第１の物体の表わす立体図形データを作成する第１の位置・形状記述手段と、第２の物体の３次元空間における位置を入力する第２の位置入力手段と、該位置に対応する第２の物体の表わす立体図形データを作成する第２の位置・形状記述手段と、第２の物体の表わす立体図形の機能状態を設定する機能設定手段と、前記第１の物体の表わす立体図形と第２の物体の表わす立体図形との干渉を検出する検出手段と、該検出手段が前記干渉を検出したとき、前記第２の物体の表わす立体図形の機能状態を表示するための制御を行う動作状態編集手段と、第１の物体の表わす立体図形データか第２の物体の表わす立体図形データかのいずれか少なくとも一方の立体図形データを拡大縮小する拡大・縮小手段

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を備えたことを特徴とする操作性評価装置。

【請求項４】　第２の物体の表わす立体図形の機能状態に合わせて制御信号を発生する制御信号発生手段を設け、動作状態編集手段の制御の下に前記制御信号発生手段から制御信号を発生させることを特徴とする請求項１から請求項３のいずれかに記載の操作性評価装置。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は、商品設計や試作等の段階で商品のデザインや機能について評価するために商品の形状を仮想的に画面に表示する評価装置に関し、特に、商品の操作部を操作したときの状況を仮想的に表示することによって商品の操作性の評価を可能にしたものである。

【０００２】

【従来の技術】近年、商品等の設計に際して、コンピュータによるＣＡＤシステムを用いて商品の形状を画面に表示し、評価を加えながら、より良い形に修正することが広く行われている。特に最近では、３次元グラフィックスを使用することにより、作成する商品の外観を立体的に表示することができ、こうした表示を通じて、商品の試作前の段階で、その形状を十分検討することができる。

【０００３】この従来のＣＡＤシステムは、図１５に示すように、キーボードやマウス等の入力手段１５１と、商品の外形を表わす図形データが記憶されている形状格納手段１５２と、入力手段１５１の入力位置に応じてその図形データを変換する形状・位置記述手段１５３と、変換された座標データに基づいて商品の外形形状を画面上に表示する表示手段１５４とを備えている。

【０００４】この装置の形状・位置記述手段１５３は、入力手段１５１から「向き」と「位置」とがデータ入力されると、形状格納手段１５２から読み出した図形データに、入力データに応じた変換（平行移動や回転）を施す。そして、変換されたデータを表示手段１５４に供給し、表示手段１５４は、与えられた図形データに基づいて商品の外形を表示する。

【０００５】そのため、利用者が入力手段１５１を動かすと、その動きに合わせて表示手段１５４上の物体が位置や向きを変えることになり、利用者は、入力手段１５１の操作を通じて任意の方向から物体の外観をチェックすることが可能になる。

【０００６】図１６には、従来のＣＡＤシステムを用いて、商品の外観をチェックするときの様子を斜視図で示している。

【０００７】

【発明が解決しようとする課題】しかし、従来の装置では、設計の段階で確認できるのは商品の外観のみで、商品が機能している状態や操作部品を操作したときの状態について表示させることができない。そのため、商品の

操作性を評価するには、実際に商品を試作しなければならないが、この試作の結果、操作性に問題がある場合には、設計だけでなく試作もやり直さなければならないので、時間的にも経済的にも、非常に大きな無駄を強いられることになる。

【０００８】本発明は、こうした従来の問題点を解決するものであり、商品の試作品を作ることなく、商品の使用感や操作性を評価することができる操作性評価装置を提供することを目的としている。

【０００９】

【課題を解決するための手段】そこで、本発明では、物体の仮想的状態を表わす立体図形を画面上に表示する操作性評価装置において、第１の物体の３次元空間における位置を入力する第１の位置入力手段と、この位置に対応する第１の物体の表わす立体図形データを作成する第１の位置・形状記述手段と、第２の物体の３次元空間における位置を入力する第２の位置入力手段と、この位置に対応する第２の物体の表わす立体図形データを作成する第２の位置・形状記述手段と、第２の物体の表わす立体図形が機能しているときの状態を設定する機能設定手段と、前記第１の物体の表わす立体図形と第２の物体の表わす立体図形との干渉を検出する検出手段と、検出手段が干渉を検出したとき、第２の物体の表わす立体図形の機能状態を表示するための制御を行う動作状態編集手段と、第１の位置・形状記述手段と第２の位置・形状記述手段における変化を記憶する状態変化記憶手段を備えた構成となっている。

【００１０】また、第１の物体の表わす立体図形と第２の物体の表わす立体図形との干渉を検出する検出手段によって検出された検出結果に基づき触感を生成する触感覚生成手段を備えた構成となっている。

【００１１】さらに、第１の物体の表わす立体図形データか第２の物体の表わす立体図形データかのいずれか少なくとも一方の立体図形データを拡大・縮小する拡大・縮小手段を備えた構成となっている。

【００１２】また、上記の手段に加え、第２の物体の表わす立体図形の機能状態に合わせて制御信号を発生する制御信号発生手段を設け、動作状態編集手段の制御の下に、この制御信号発生手段から制御信号を発生させるように構成している。

【００１３】

【作用】そのため、第１の物体を第２の物体に接触させると、画面上に、第２の物体の表わす立体図形の操作された状態が表示されるとともに、各物体の状態変化を記憶しているため、利用者は、第１の物体と第２の物体とを接触させたときの感触を体感し、そのときの仮想的状態を画面で視認することができるのみならず、一度行った操作を繰り返すことなく操作の修正、再評価をもおこなうことができる。

【００１４】また、触感覚生成手段により手に触った感覚を疑似的に経験することにより、より現実に即した操作性の評価が可能となる。

【００１５】また、、拡大・縮小手段により様々な利用者を想定した操作性の評価が可能となる。

【００１６】さらに、第１の物体を第２の物体に接触させると、制御信号が出力され、そのときに実際に起きる動作と同じ動作が発生する。したがって、利用者は、実際に即した状態で商品の評価を行うことができる。

【００１７】

【実施例】

（実施例１）本発明の第１の実施例における操作性評価装置は、例えば、図５（ａ）に示すように、利用者が、手の指にその３次元位置を測定する位置入力手段１１を装着して、製作しようとする商品の外形を型取った商品モデル２３（このモデル２３にも、３次元位置を測定する位置入力手段が埋め込まれている）を手に取り、商品の操作部の設置予定箇所を指で模擬的に操作すると、図５（ｂ）に示すように、画面上にあたかも、実際の商品における操作部を指で操作しているかのような、仮想的状況を表示することができる。

【００１８】この操作性評価装置は、図１に示すように、指に相当する第１物体の３次元位置を測定する位置入力手段１と、商品の外形を型どったモデル２３に相当する第２物体の３次元位置を入力する位置入力手段２と、第１物体の外形形状を表わす図形データを作成する位置・形状記述手段３と、第２物体の外形形状を表わす図形データを作成する位置・形状記述手段４と、第２物体に設置される操作部分の設計位置や操作に伴う動き等を設定する機能設定手段５と、第１物体と第２物体との接触状況をチェックし接触位置に設置される予定の操作部品を検出する接触状態検出手段６と、操作部品の動作状態を表わす表示を制御する動作状態編集手段７と、第１物体と第２物体とを表示する表示手段８とを備えている。

【００１９】第１物体の位置入力手段１は、図２（ａ）に示すように、手指への装着部１１に固着された磁気センサー１２であり、位置検出の基準となる磁気発生装置１０から発生された磁界のｘ，ｙ，ｚ方向の各強さ検出することによって、３次元空間における現在の位置と向きとを測定する。

【００２０】また、第２物体は、図２（ｂ）に示すように、商品の外形を型どったモデル２３であり、その位置入力手段２として、モデル２３の内部に磁気センサー２４が埋め込まれ、磁気発生装置１０から発生される磁界の強さを検出して、モデル２３の置かれている現在の位置と向きとを測定する。

【００２１】図３は、磁気センサーの説明図である。図３において３１は磁場発生コイル、３２は受信コイルであり、それぞれ直行した３つのコイルから構成されている。磁場は３１の３つの発信コイルから順に発生され

る。この磁場の中に、３２のような受信コイルを置くと、受信コイルのそれぞれに電流が発生し、この電流の大きさから受信コイル３２の３次元的な位置が検出される。発信コイル３１は磁気発生装置１０の内部にあり、受信コイル３２はセンサー１２、２４の内部にある。

【００２２】操作者が商品の操作を模擬的に行う場合には、図４（ａ）に示すように、磁気センサーが固定された装着部１１を指に填め、磁気センサーが埋め込まれたモデル２３を手で掴む。こうすると、指及びモデル２３の位置と向きとがセンサー１２および２４によって測定され、測定データが第１物体の位置・形状記述手段３および第２物体の位置・形状記述手段４に送られる。

【００２３】第１物体および第２物体の位置・形状記述手段３、４は、それぞれの物体の外形形状を構成する面の頂点の座標データ（初期値）を図形データとして保持している。

【００２４】また、機能設定手段５は、操作者によって設定された機能に関するデータ、即ち、操作ボタンやスライダー等の操作部品の数、操作部品を配置する商品の面、操作部品の形状、商品面上の操作部品の位置、操作部品が機能しているときの形状等についてのデータを保持しており、これらのデータを第２物体の位置・形状記述手段４に供給する。

【００２５】第１物体の位置・形状記述手段３は、第１物体位置入力手段１から測定データが入力されると、保持している図形データに対して、測定された第１物体の位置や向きに応じた平行移動や回転のデータ処理を施して、処理後のデータを表示手段８に送る。

【００２６】また、第２物体の位置・形状記述手段４は、保持している図形データと機能設定手段５から入力されたデータとを合わせて、操作部品の配置された商品の図形データを構成し、この図形データに対して、第２物体の位置入力手段２から入力された観測データに応じたデータ処理を施し、処理後のデータの内、操作部品が機能していない状態を表わす図形データを、まず、表示手段８に送る。

【００２７】そのため、表示画面には、図４（ｂ）に示すように、第１物体に対応する模擬指と、第２物体に対応する、操作部品が設置された商品とが表示され、これらの表示は、利用者が指を動かしたり、モデルを動かしたりすると、それと同じように画面上を移動する。

【００２８】なお、図４では、ビデオデッキのリモコンを例に取り上げ、画面上のリモコン（第２物体）に、機能設定手段５で規定された各種機能を持つボタンが配置されている様子を示している。

【００２９】このリモコン上のボタンは、第１物体によって操作することができる。これを行うときは、図５（ａ）に示すように、表示画面上で第１物体が第２物体上のボタンと重なるように、位置入力手段１（１１）を装着した指で第２物体のモデル２３の表面ボタン設置予定位置を押す。

【００３０】このとき、接触状態検出手段６は、第１物体の図形データにおける面と第２物体の図形データにおける面との距離を計算し、その距離が０となる、面の重なる位置を干渉位置として検出し、干渉位置に位置するボタンを調べて、動作状態編集手段７に伝える。

【００３１】図６は干渉位置を検出する動作を示した図である。２つの物体の干渉をチェックする際には、物体を面に分解し、各面毎に干渉の有無をチェックしていく。図６で６１は物体１を、６２は物体２を示しておりいずれも直方体で６つの面によって構成されている。最初に図６に示すように、物体２を構成する面の一つと物体１を構成している面すべてが重なり合っているかどうかチェックする。もし、いずれの面かが重なり合っていれば、２つの物体は干渉しているものとみなす。

【００３２】もし、重なり合っていなければ物体２の次の面について同様のチェックをする。このようにして物体２のすべての面と、物体１のすべての面が重なり合っていなければ、２つの物体は干渉していないものとする。

【００３３】このような干渉チェックにより、干渉位置に位置するボタンの情報を受けた動作状態編集手段７は、第２物体の位置・形状記述手段４に対して、該当するボタンの操作状態を表示する画像データの送出を命令し、第２物体の位置・形状記述手段４は、操作されたボタンの押し下げられた状態を示す画像データを表示手段８に送出する。

【００３４】その結果、表示手段８の画面には、図５（ｂ）に示すように、疑似指がリモコンのボタンを押下げている状況が表示される。

【００３５】なお、操作部品の操作状態は、該当する操作部品を他の部品よりも明るい色で強調表示したり、動作を説明する説明文を画面に登場させることで表現することもできる。

【００３６】こうした表示によって、利用者は、自分がリモコンのどのボタンを押したのかを確認することができる。

【００３７】このような操作を行って、第２物体上に配置されたボタンの位置や形状などが不適当であると判断された場合には、機能設定手段５に与える操作部品の記述を変更することにより、それらを即座に変更することができる。操作者は、納得できる操作性が得られるまで、何度でもボタンの位置や形状等を変更することができる。

【００３８】また、第１物体は、接触した状態で他方の部材の新たな動きを引き起こす部材であれば手指以外の物であってもよい。

【００３９】（実施例２）第２の実施例の操作性評価装置は、商品の操作部分を仮想的に操作したとき、操作状態が画面に表示されると共に、操作に伴う動作が実際に

発生するように構成されている。

【００４０】この装置は、図７に示すように、押下げられた操作部品の種類に応じた制御信号を発生する制御信号発生手段９と、この制御信号によって起動される装置１３とを備えている。この装置１３には、製造しようとする商品がビデオのリモコンである場合、リモコンで操作されるビデオ装置が用意される。その他の構成は、第１実施例の装置（図１）と変わりがない。

【００４１】また、図８に示すように、制御信号発生手段９に代え、制御信号発生手段の機能に通信機能を備えた通信情報発生手段１４を用いることも可能である。

【００４２】操作者の操作の仕方は、第１実施例の場合と同じである。位置入力手段１を装着した指でリモコン・モデル２３の表面のボタン設置予定位置を押すと、接触状態検出手段６が押された位置に配置される予定のボタンを調べて、動作状態編集手段７に伝え、動作状態編集手段７は、第２物体の位置・形状記述手段４に対して、該当するボタンの操作状態を表示する画像データの送出を指令すると共に、制御信号発生手段９（通信情報発生手段１４）に対して、該当するボタンが押されたときの制御信号を発生するように指令する。

【００４３】押されたボタンが、例えばプレイ・ボタンであるときは、制御信号発生手段９（通信情報発生手段１４）からプレイを起動する信号が出力され、それにしたがってビデオ装置１３がプレイ動作を開始する。

【００４４】このように、この装置では、商品のボタンを仮想的に操作したとき、その状態が画面に表示されると同時に、そのボタン操作による動作が再現される。そのため、操作者は、ボタンを操作したときの状況を実感することができ、商品の評価を実態に即して行うことができる。

【００４５】（実施例３）第３の実施例の操作性評価装置は、第１物体および第２物体の位置・形状の変化を記憶するように構成されている。

【００４６】この装置は、図９に示すように第１物体の位置・形状記憶手段３と第２物体の位置・形状記憶手段４に対し、それぞれの物体の変化を記憶する状態変化記憶手段１５が接続されている。状態変化記憶手段１５には、一定時間間隔、及び干渉発生毎に物体１、物体２の状態の変化が記憶される。その他の構成は、第１実施例の装置（図１）と変わりがない。

【００４７】状態変化記憶手段１５には、例えば図１０（ａ）に示すデータ形式で物体の移動が記憶される。図１０（ｂ）は、物体の位置情報を示す説明図である。３次元空間中のベクトルの位置は図１０（ｂ）に示すようにベクトルの起点１０１の位置（ｘ，ｙ，ｚ）と１０２で示すベクトルの向き（α、β、γ）によって与えられる。物体１の位置は図１０（ｃ）に示すように物体１に固定されたベクトルで表され、ベクトルの起点１０３およびベクトルの向き１０４が物体１の位置を表す。物体１が図１０（ｃ）の様に移動すると物体１に固定されたベクトルも移動する。このベクトルの向きを利用して、図１０（ａ）に示すように物体１と物体２の移動を記憶する。

【００４８】操作者の操作の仕方は、第１実施例の場合と同じであが、状態変化記憶手段１５には一定時間毎に第１物体の位置・形状記述手段のデータ、及び第２物体の位置・形状記述手段のデータが記憶される。また、接触状態検出手段６は物体１と物体２の干渉を検出した場合に、状態変化記憶手段１５に状態を記憶すべき指令を出し、状態変化記憶手段１５はその時点の状態を記憶する。

【００４９】一連の操作が終了した段階で、操作者は状態変化記憶手段１５に記憶されたデータをそれぞれの位置・形状記述手段を介して、または、直接表示手段８に表示させることができる。そのため、操作者は一連の操作が終わった後で、一度行った操作を繰り返すことなく何回でも同じ操作を見ながら操作の再評価をおこなうことができる。

【００５０】また、必用に応じて状態変化記憶手段１５に記憶されたデータを修正することにより、一度行った操作を活用した、効率的な操作の修正等が可能となる。

【００５１】（実施例４）第４の実施例の操作性評価装置は、接触状態検出手段６からの信号に基づき操作部品を手で触った感覚を疑似的に再現するように構成されている。

【００５２】この装置は、図１１に示すように、接触状態検出手段６からの信号に基づき動作する触感覚生成手段１６を備えている。その他の構成は、第１実施例の装置（図１）と変わりがない。

【００５３】触感覚生成手段１６は図１２（ｃ）に示すように空気の入る管１２１をもっており、接触状態検出手段６からの信号に連動して空気が送られて来ると１２２のように空気の入る部屋に空気が入り幕１２３が膨らむことによって指を押し触った感覚を得ることが出来る。図１２（ａ）は物体１と触感覚生成手段１６の透視図、図１２（ｂ）は物体１を手元の方からみた透視図である。

【００５４】このように触感覚生成手段１６により手に触った感覚を疑似的に経験することにより、より現実に即した操作性の評価が可能となる。

【００５５】（実施例５）第５の実施例の操作性評価装置は、第１の物体の表わす立体図形データか第２の物体の表わす立体図形データかのいずれか少なくとも一方の立体図形データを拡大縮小できるように構成されている。

【００５６】この装置は、図１３に示すように第１物体の位置・形状記述手段３に格納された第１の物体の表わす立体図形データを拡大・縮小処理する第１の拡大・縮小手段１７と、第２物体の位置・形状記述手段４に格納

された第２の物体の表わす立体図形データを拡大・縮小処理する第２の拡大・縮小手段１８とを備えた構成となっている。その他の構成は、第１実施例の装置（図１）と変わりがない。

【００５７】図１４は拡大縮小手段１７および１８の働きを示した物である。図１４（ａ）のように物体１を指にはめて物体２を持って操作すると表示手段手段８には最初図１４（ｂ）のような画像が現われる。もう少し手の大きい人の操作をシミュレートしたい場合には、第１の拡大縮小手段により物体１を拡大する。すると、同じ手の動きにより図１４（ｃ）のような画像を得ることが出来る。

【００５８】第１及び第２の２つの拡大・縮小手段を設けることにより実際のリモコン・モデル２３の大きさに制限されることなくこの操作が可能となる。即ち、第２の拡大・縮小手段だけでは、干渉位置の下限は現実のリモコン・モデルの大きさにより制限されるが、第１の拡大・縮小手段を設け、第１物体を拡大・縮小することにより現実のリモコン・モデルの大きさ制限されることなく干渉位置の設定が可能となる。このようにして、手の大きさ、リモコン・モデルの大きさを仮想的に変更しながら、干渉位置を自由に設定して操作性のテストが可能となる。

【００５９】なお、本実施例では物体１を手として表現したが、他の実施例と同様の表現ででも同じ効果が得られることは明かである。

【００６０】

【発明の効果】以上の実施例の説明から明かなように、本発明の操作性評価装置では、開発しようとする商品の操作部が操作された状態を３次元画像で確認しながら、同時に、その操作部を操作するときの感触や操作性を確かめることができ、さらに、一連の操作が終わった後に、一度行った操作を活用し効率的な操作の評価をおこなうことができる。

【００６１】また、触感覚生成手段により手に触った感覚を疑似的に経験することにより、より現実に即した操作性の評価が可能となる。

【００６２】また、拡大・縮小手段により様々な利用者を想定した操作性の評価が可能となる。

【００６３】また、操作部を操作したときの動作を実態に即してシュミレーションすることができるため、的確な操作性操作性の評価が可能になる。

【図面の簡単な説明】

【図１】本発明の第１の実施例における操作性評価装置の構成を示すブロック図

【図２】実施例の操作性評価装置における位置入力手段の第１の説明図

【図３】実施例の操作性評価装置における位置入力手段の第２の説明図

【図４】実施例の装置での商品操作方法と表示画面図

【図５】実施例の装置で商品の操作性を評価する時の操作と画面図

【図６】実施例における接触状態検出手段６の説明図

【図７】本発明の第２の実施例における操作性評価装置の構成を示す第１のブロック図

【図８】本発明の第２の実施例における操作性評価装置の構成を示す第２のブロック図

【図９】本発明の第３の実施例における操作性評価装置の構成を示すブロック図

【図１０】第３の実施例における状態変化記憶手段１５の動作説明図

【図１１】本発明の第４の実施例における操作性評価装置の構成を示すブロック図

【図１２】第４の実施例における触感覚生成手段１６の構成を示す概念図

【図１３】本発明の第５の実施例における操作性評価装置の構成を示すブロック図

【図１４】第５の実施例における商品操作方法と表示画面図

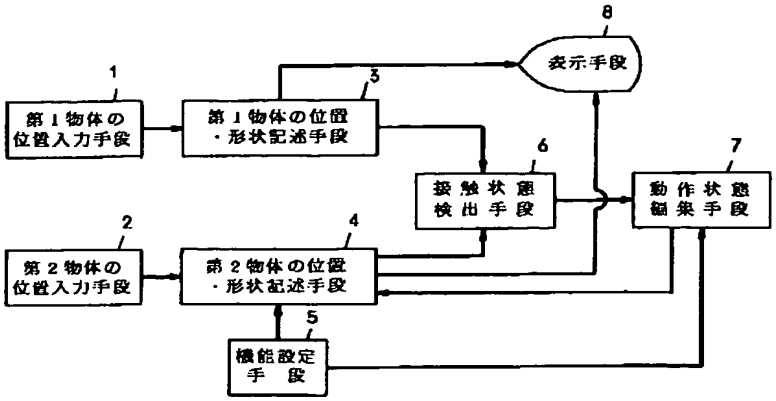
【図１５】従来のＣＡＤシステムの構成を示すブロック図

【図１６】従来のシステムの外観図

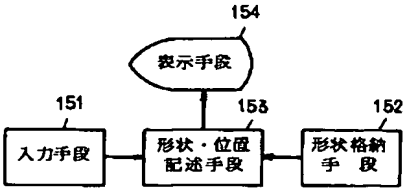
【符号の説明】

１　第１物体の位置入力手段
２　第２物体の位置入力手段
３　第１物体の位置・形状記述手段
４　第２物体の位置・形状記述手段
５　機能設定手段
６　接触状態検出手段
７　動作状態編集手段
８　表示手段
９　制御信号発生手段
１０　磁気発生装置
１１　装着部
１２　センサー
１３　ビデオ装置
１４　通信情報発生手段
１５　状態変化記憶手段
１６　触感覚生成手段
１７　第１の拡大・縮小手段
１８　第２の拡大・縮小手段
３１　発信コイル
３２　受信コイル
２３　モデル
６１　物体１
６２　物体２
１５１　入力手段
１５２　形状格納手段
１５３　形状・位置記述手段
１５４　表示手段

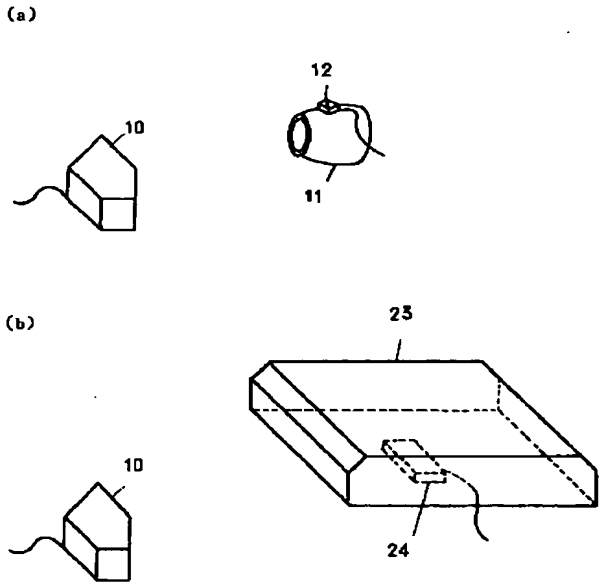
【図１】



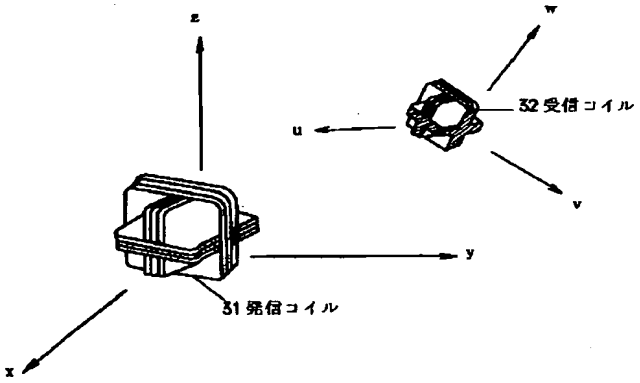
【図１５】



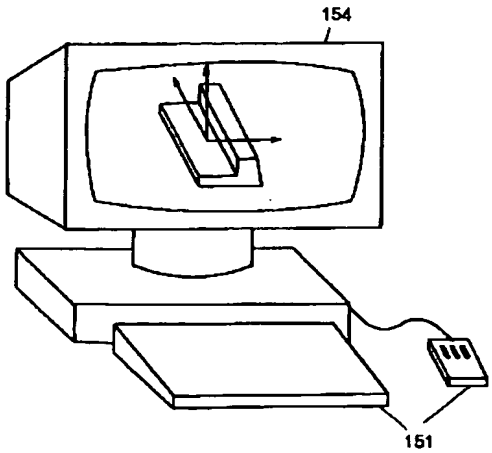
【図２】



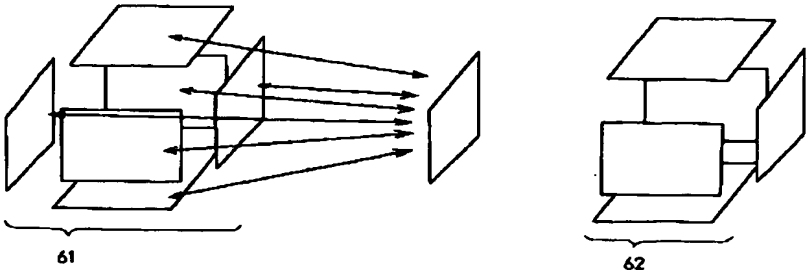
【図３】



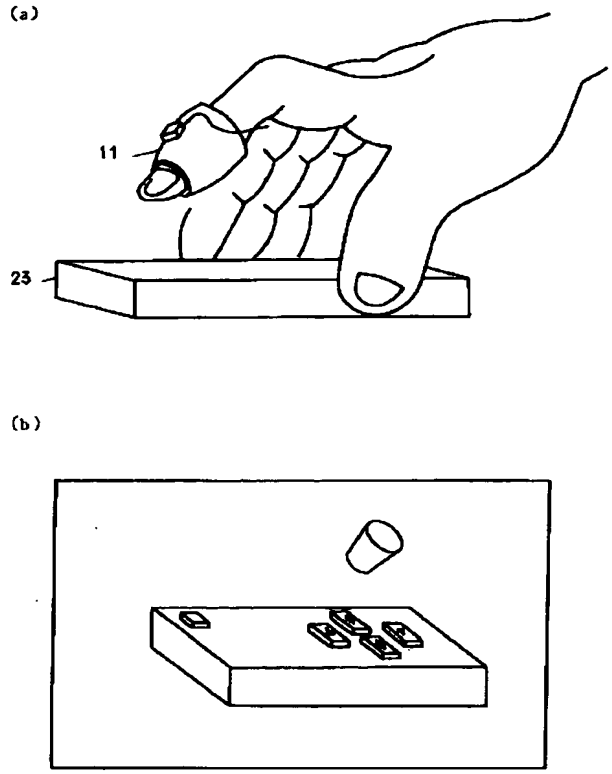
【図１６】



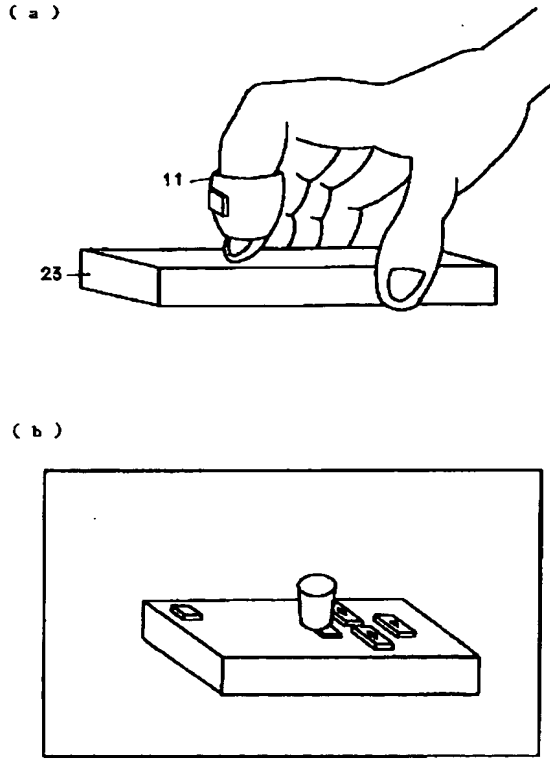
【図６】



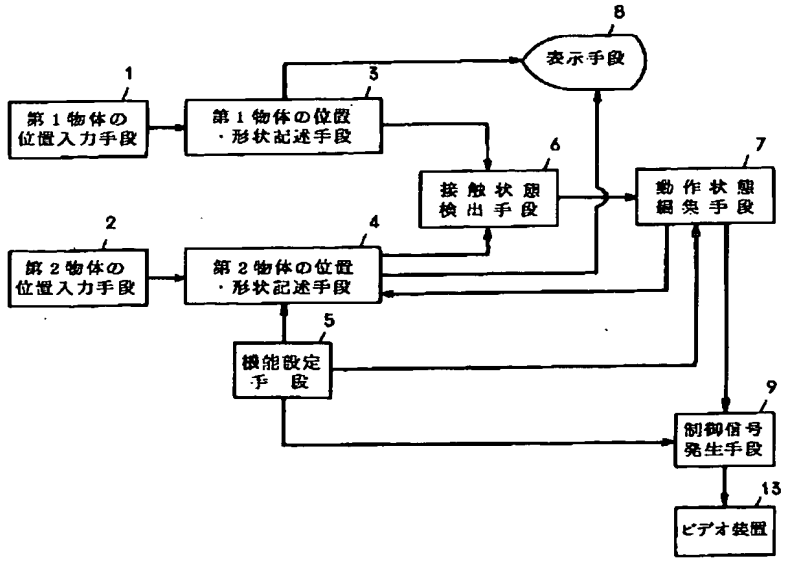
【図４】


(a)
11
23
(b)

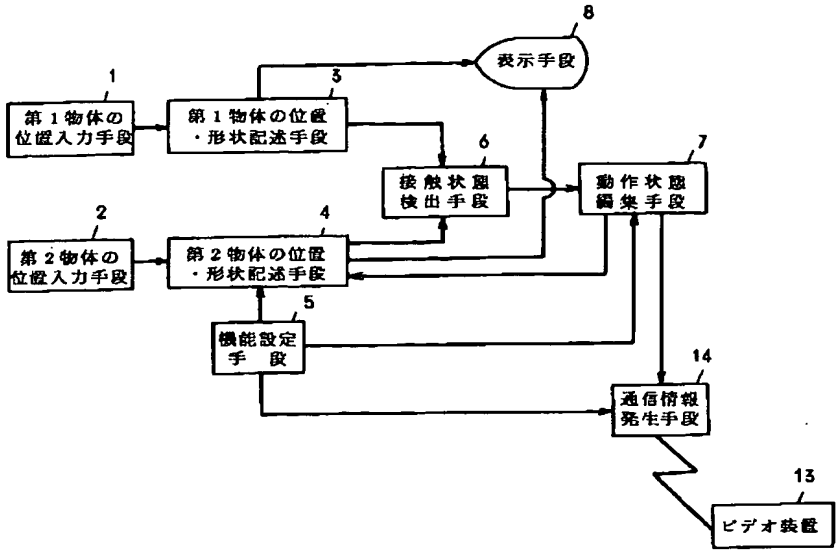
【図５】


(a)
11
23
(b)

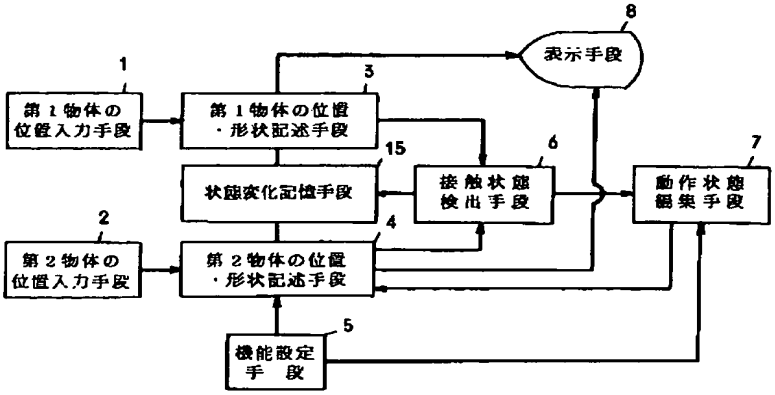
【図７】


8
表示手段
1
第１物体の位置入力手段
3
第１物体の位置・形状記述手段
6
接触状態検出手段
7
動作状態編集手段
2
第２物体の位置入力手段
4
第２物体の位置・形状記述手段
5
機能設定手段
9
制御信号発生手段
13
ビデオ装置

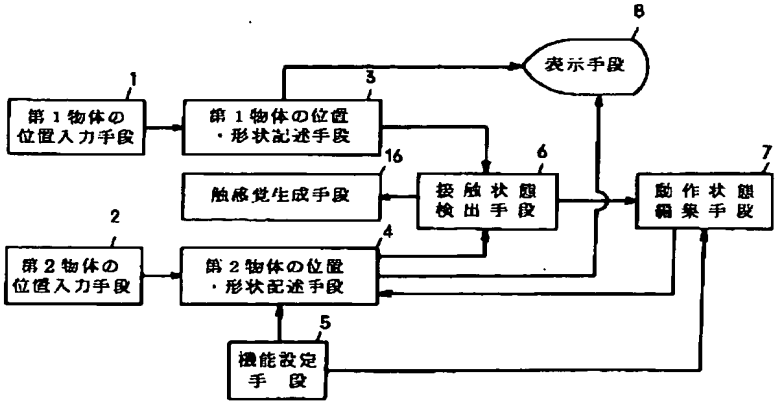
【図８】



【図９】



【図１１】

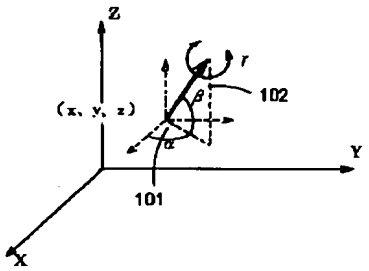


【図１０】

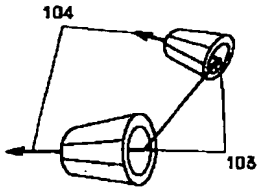
(a)

物体１の動き （x、y、z、α、β、γ）
物体２の動き （x、y、z、α、β、γ）
物体１の動き （x、y、z、α、β、γ）
…
…
…

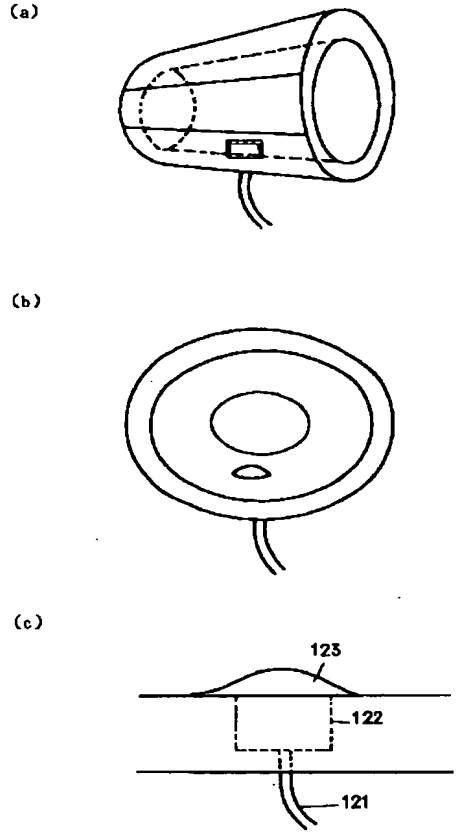
(b)



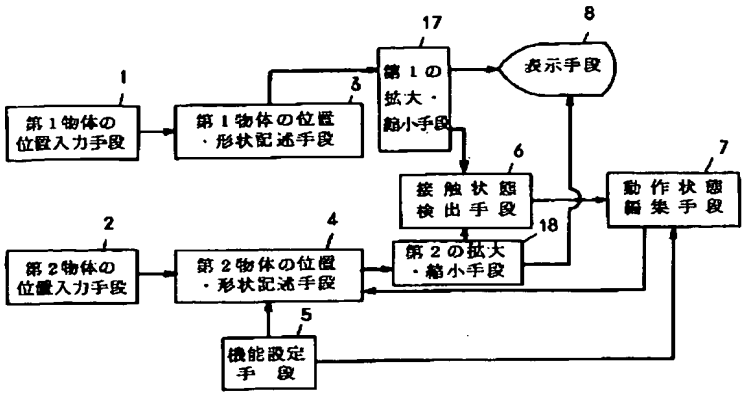
(c)



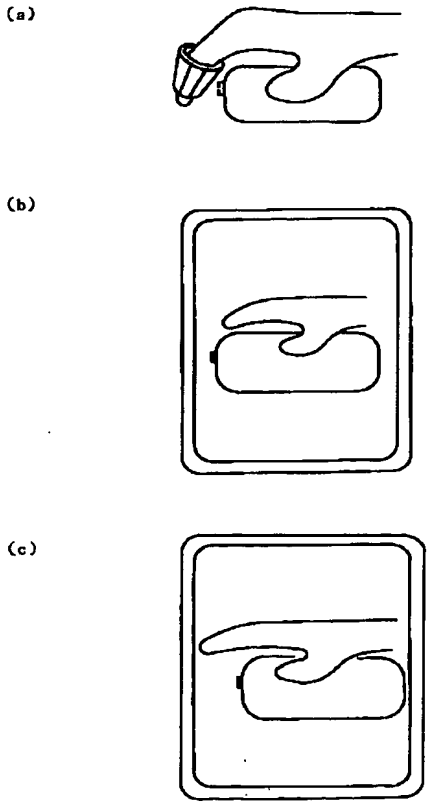
【図１２】



【図１３】



【図１４】



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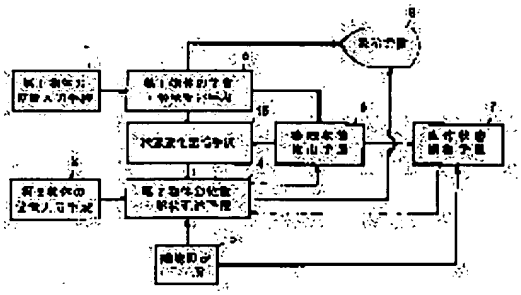
(54) OPERABILITY EVALUATION DEVICE

(57)Abstract:

PURPOSE: To constitute an operability evaluation device provided with improved characteristics capable of evaluating operability by solving a problem that a trial piece is to be prepared so as to evaluate the operability of a product, preparing only a shape model and virtually performing an operation relating to the operability evaluation device used in product design.



CONSTITUTION: An object 2 on a display means 8 for which buttons are arranged by using a function setting means 5 is moved with a position input means 2 for second object of the object 2 in the shape of the object 2. Button operations or the like are virtually performed to the object 2 with a position input means 1 of a first object fitted to the finger, states corresponding to the operations are displayed at the display means 8 and the state change of the respective objects is stored in a state change storage means 15. Thus, the operation performed once is utilized and the operability is efficiently evaluated.

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* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] In the operability evaluation equipment which displays the solid figure showing an objective virtual condition on a screen 1st location input means to input the location in the three-dimension space of the 1st body, The 1st location and configuration description means which creates the solid figure data which the 1st body corresponding to this location expresses, 2nd location input means to input the location in the three-dimension space of the 2nd body, The 2nd location and configuration description means which creates the solid figure data which the 2nd body corresponding to this location expresses, When a detection means to detect interference with a functional setting means to set up the functional condition of the solid figure which the 2nd body expresses, and the solid figure which said 1st body expresses and the solid figure which the 2nd body expresses, and this detection means detect said interference, Operability evaluation equipment characterized by having a change-of-state storage means to memorize the change of state of the solid figure data in an operating state edit means to perform control for displaying the functional condition of the solid figure which said 2nd body expresses, the 1st location and configuration description means, and the 2nd location and configuration description means.

[Claim 2] In the operability evaluation equipment which displays the solid figure showing an objective virtual condition on a screen 1st location input means to input the location in the three-dimension space of the 1st body, The 1st location and configuration description means which creates the solid figure data which the 1st body corresponding to this location expresses, 2nd location input means to input the location in the three-dimension space of the 2nd body, The 2nd location and configuration description means which creates the solid figure data which the 2nd body corresponding to this location expresses, When a detection means to detect interference with a functional setting means to set up the functional condition of the solid figure which the 2nd body expresses, and the solid figure which said 1st body expresses and the solid figure which the 2nd body expresses, and this detection means detect said interference, Operability evaluation equipment characterized by having an operating state edit means to perform control for displaying the functional condition of the solid figure which said 2nd body expresses, and a tactile-sense generation means to generate tactile feeling based on the detection result detected by the detection means.
[Claim 3] In the operability evaluation equipment which displays the solid figure showing an objective virtual condition on a screen 1st location input means to input the location in the three-dimension space of the 1st body, The 1st location and configuration description means which creates the solid figure data which the 1st body corresponding to this location expresses, 2nd location input means to input the location in the three-dimension space of the 2nd body, The 2nd location and configuration description means which creates the solid figure data which the 2nd body corresponding to this location expresses, When a detection means to detect interference with a functional setting means to set up the functional condition of the solid figure which the 2nd body expresses, and the solid figure which said 1st body expresses and the solid figure which the 2nd body expresses, and this detection means detect said interference, An operating state edit means to perform control for displaying the functional condition of

the solid figure which said 2nd body expresses, Operability evaluation equipment characterized by having the zooming means which carries out enlarging or contracting of one solid figure data even if there is little solid figure data which the 1st body expresses, or solid figure data which the 2nd body expresses either.

[Claim 4] Operability evaluation equipment given in either of claim 1 to claims 3 characterized by establishing a control signal generating means to generate a control signal according to the functional condition of the solid figure which the 2nd body expresses, and generating a control signal from said control signal generating means under control of an operating state edit means.

[Translation done.]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention enables evaluation of the operability of goods by displaying virtually the situation when operating the control unit of goods especially about the evaluation equipment which displays the configuration of goods on a screen virtually, in order to evaluate about the design and function of goods in phases, such as a goods design and a prototype.
[0002]
[Description of the Prior Art] Correcting to a better form is performed widely, displaying the configuration of goods on a screen using the CAD system by the computer, and adding evaluation on the occasion of the design of goods etc., in recent years. By especially using 3D-Graphics recently, the appearance of the goods to create can be displayed in three dimensions, and the configuration can be enough examined in the phase before the prototype of goods through such a display.
[0003] This conventional CAD system is equipped with the input means 151, such as a keyboard and a mouse, a configuration storing means 152 to by_which the graphic data showing the appearance of goods are memorized, the configuration and the location description means 153 change those graphic data according to the input location of the input means 151, and a display means 154 display the appearance configuration of goods on a screen based on the changed coordinate data as shown in drawing 15 .
[0004] The configuration and the location description means 153 of this equipment will perform conversion (a parallel displacement and rotation) to the graphic data read from the configuration storing means 152 according to input data, if the data input of the "sense" and the "location" is carried out from the input means 151. And the changed data are supplied to the display means 154, and the display means 154 displays the appearance of goods based on the given graphic data.
[0005] Therefore, if a user moves the input means 151, according to the motion, the body on the display means 154 will change a location and the sense, and it will enable a user to check an objective appearance from the direction of arbitration through actuation of the input means 151.
[0006] The perspective view shows the situation when checking the appearance of goods to drawing 16 using the conventional CAD system.
[0007]
[Problem(s) to be Solved by the Invention] However, it is only the appearance of goods which can be checked in the phase of a design, and it cannot make it display about the condition when operating the condition that goods are functioning, and actuating parts with conventional equipment. Therefore, since not only a design but a prototype must be redone when a problem is in operability as a result of this prototype although goods must actually be made as an experiment in order to evaluate the operability of goods, also in time, it will be forced economical very big futility.
[0008] This invention aims at offering the operability evaluation equipment by which the feeling of use and operability of goods can be evaluated, without solving such a conventional trouble and making the prototype of goods.

[0009]
[Means for Solving the Problem] Then, it sets to the operability evaluation equipment which displays the solid figure showing an objective virtual condition on a screen in this invention. 1st location input means to input the location in the three-dimension space of the 1st body, The 1st location and configuration description means which creates the solid figure data which the 1st body corresponding to this location expresses, 2nd location input means to input the location in the three-dimension space of the 2nd body, The 2nd location and configuration description means which creates the solid figure data which the 2nd body corresponding to this location expresses, When a detection means to detect interference with a functional setting means to set up a condition when the solid figure which the 2nd body expresses is functioning, and the solid figure which said 1st body expresses and the solid figure which the 2nd body expresses, and a detection means detect interference, It has composition equipped with a change-of-state storage means to memorize the change in an operating state edit means to perform control for displaying the functional condition of the solid figure which the 2nd body expresses, the 1st location and configuration description means, and the 2nd location and configuration description means.
[0010] Moreover, it has composition equipped with a tactile-sense generation means to generate tactile feeling based on the detection result detected by detection means to detect interference with the solid figure which the 1st body expresses, and the solid figure which the 2nd body expresses.
[0011] Furthermore, even if there is little solid figure data which the 1st body expresses, or solid figure data which the 2nd body expresses either, it has composition equipped with the zooming means which carries out zooming of one solid figure data.
[0012] Moreover, in addition to the above-mentioned means, a control signal generating means to generate a control signal according to the functional condition of the solid figure which the 2nd body expresses is established, and it constitutes so that a control signal may be generated from this control signal generating means under control of an operating state edit means.
[0013]
[Function] Therefore, if the 1st body is contacted on the 2nd body, while the condition that the solid figure which the 2nd body expresses was operated will be displayed on a screen Since the change of state of each body is memorized, a user feels the feel when contacting the 1st body and 2nd body, and he can also perform correction of actuation, and reevaluation, without repeating the actuation which it not only can check the virtual condition at that time by looking in the pictures, but performed it once.
[0014] Moreover, evaluation of the operability based more on reality is attained by experiencing in false the feeling which touched the hand with the tactile-sense generation means.
[0015] Moreover, evaluation of the operability which assumed various users with the zooming means is attained.
[0016] Furthermore, if the 1st body is contacted on the 2nd body, a control signal will be outputted and the same actuation as the actuation which actually breaks out then will occur. Therefore, a user can evaluate goods by the condition of actually having been based.
[0017]
[Example]
(Example 1) The operability evaluation equipment in the 1st example of this invention For example, as shown in drawing 5 (a), a user equips the digiti manus with a location input means 11 to measure the three-dimension location. If the ******** goods model 23 (a location input means to measure a three-dimension location is embedded also to this model 23) is taken in its hand for the appearance of the goods which it is going to manufacture and the installation schedule part of the control unit of goods is operated in simulation with a finger As shown in drawing 5 (b), a virtual situation as if it was operating the control unit in actual goods with the finger can be displayed on a screen.
[0018] A location input means 1 to measure the three-dimension location of the 1st body equivalent to a finger as this operability evaluation equipment is shown in drawing 1 , A location input means 2 to input the three-dimension location of the 2nd body which is equivalent to the ******** model 23 in the appearance of goods, The location and a configuration description means 3 to create the graphic data

showing the appearance configuration of the 1st body, The location and a configuration description means 4 to create the graphic data showing the appearance configuration of the 2nd body, A functional setting means 5 to set up the design location of the operating part installed in the 2nd body, the motion accompanying actuation, etc., It has a display means 8 to display a contact condition detection means 6 to detect the actuating parts of a schedule which check the contact situation of the 1st body and the 2nd body, and are installed in a contact location, an operating state edit means 7 to control the display showing the operating state of actuating parts, and the 1st body and the 2nd body.

[0019] As shown in drawing 2 (a), the location input means 1 of the 1st body is the magnetic sensor 12 which fixed to the applied part 11 to a finger, and measures the present location and present sense in three-dimension space by [of x of the field generated from the magnetic generator 10 used as the criteria of location detection, y, and the direction of z / each] carrying out intensity detection.

[0020] Moreover, the 2nd body measures the present location and present sense on which it is the ******** model 23 about the appearance of goods, and the magnetic field strength which a magnetic sensor 24 is embedded to the interior of a model 23 as the location input means 2, and is generated from the magnetic generator 10 is detected, and the model 23 is put, as shown in drawing 2 (b).

[0021] Drawing 3 is the explanatory view of a magnetic sensor. In drawing 3 , 31 is a magnetic field generating coil, 32 is a receiver coil, and it consists of three coils which went direct, respectively. A magnetic field is generated sequentially from three dispatch coils of 31. If a receiver coil like 32 is placed into this magnetic field, a current will occur in each of a receiver coil and the three-dimension-location of a receiver coil 32 will be detected from the magnitude of this current. The dispatch coil 31 is in the interior of the magnetic generator 10, and a receiver coil 32 is in the interior of sensors 12 and 24.

[0022] When an operator operates goods in simulation, as shown in drawing 4 (a), the applied part 11 to which the magnetic sensor was fixed is inserted in a finger, and the model 23 with which the magnetic sensor was embedded is held by hand. If it carries out like this, a finger, and the location and sense of a model 23 will be measured by sensors 12 and 24, and measurement data will be sent to the location and the configuration description means 3 of the 1st body, and the location and configuration description means 4 of the 2nd body.

[0023] The location and the configuration description means 3 and 4 of the 1st body and the 2nd body hold the coordinate data (initial value) of the top-most vertices of the field which constitutes the appearance configuration of each body as graphic data.

[0024] Moreover, the functional setting means 5 holds the data about a configuration when the location of the number of actuating parts, such as the data about the function set up by the operator, i.e., a manual operation button, and a slider, the field of the goods which arrange actuating parts, the configuration of actuating parts, and the actuating parts on a goods side, and actuating parts are functioning etc., and supplies these data to the location and the configuration description means 4 of the 2nd body.

[0025] If measurement data is inputted from the 1st body location input means 1, the location and the configuration description means 3 of the 1st body will perform parallel translation according to the location and sense of the 1st body which were measured, and rotational data processing to the graphic data currently held, and will send the data after processing to the display means 8.

[0026] Moreover, the location and the configuration description means 4 of the 2nd body set the data inputted from the graphic data currently held and the functional setting means 5, and constitutes the graphic data of the goods with which actuating parts have been arranged, and these graphic data are received. Data processing according to the observation data inputted from the location input means 2 of the 2nd body is performed, and the graphic data showing the condition that actuating parts are not functioning among the data after processing are first sent to the display means 8.

[0027] Therefore, the simulation finger corresponding to the 1st body and the goods corresponding to the 2nd body with which actuating parts were installed are displayed, and as shown in drawing 4 (b), these displays will move a screen top to the display screen like it, if a user moves a finger or moves a model.

[0028] In addition, by drawing 4 , remote control of a videocassette recorder is taken up for an example, and signs that the carbon button with the various functions specified to the remote control on a screen

(the 2nd body) with the functional setting means 5 is arranged are shown.
[0029] The carbon button on this remote control can be operated with the 1st body. When performing this, as shown in drawing 5 (a), the surface carbon button installation predetermined position of the model 23 of the 2nd body is pushed with the finger equipped with the location input means 1 (11) so that the 1st body may lap with the carbon button on the 2nd body on a display screen.
[0030] At this time, the contact condition detection means 6 investigates the carbon button which detects the location where the distance of the field in the graphic data of the 1st body and the field in the graphic data of the 2nd body is calculated, and that distance becomes 0, and with which a field laps as an interference location, and is located in an interference location, and tells the operating state edit means 7.

[0031] Drawing 6 is drawing having shown the actuation which detects an interference location. In case interference of two bodies is checked, a body is disassembled into a field and the existence of interference is checked for every field. By drawing 6 , 61 shows a body 1, 62 shows the body 2, and all are constituted from a rectangular parallelepiped by six fields. First, as shown in drawing 6 , it is confirmed whether all the fields that constitute one and the body 1 of the field which constitutes a body 2 overlap. If whether it is which field overlap, it will be considered that two bodies are those in which it has interfered.
[0032] If it does not overlap, the check same about the next field of a body 2 is carried out. Thus, if none of the fields of a body 2 and all the fields of a body 1 overlaps, it shall not have interfered in two bodies.

[0033] An operating-state edit means 7 to by_which such an interference check received the information on a carbon button are located in an interference location orders sending out of the image data which displays the actuation condition of the corresponding carbon button to the location and the configuration description means 4 of the 2nd body, and the location and the configuration description means 4 of the 2nd body sends out the image data which shows the condition that the operated carbon button was depressed to a display means 8.
[0034] Consequently, as shown in drawing 5 (b), the situation that the false finger is depressing the carbon button of remote control is displayed on the screen of the display means 8.
[0035] In addition, the actuation condition of actuating parts can carry out highlighting of the corresponding actuating parts in a color brighter than other components, or can also express the explanatory note explaining actuation by making it appear in a screen.
[0036] By such display, a user can check which carbon button of remote control he has pushed.
[0037] They can be immediately changed by performing such actuation, and changing description of the actuating parts given to the functional setting means 5, when it is judged that a location, a configuration, etc. of a carbon button which have been arranged on the 2nd body are unsuitable. An operator can change a location, a configuration, etc. of a carbon button any number of times until the operability to which can be convinced is acquired.
[0038] Moreover, as long as the 1st body is a member which causes a new motion of the member of another side in the condition of having contacted, it may be objects other than a finger.
[0039] (Example 2) The operability evaluation equipment of the 2nd example is constituted so that the actuation accompanying actuation may actually occur, while an actuation condition is displayed on a screen, when the operating part of goods is operated virtually.
[0040] This equipment is equipped with a control signal generating means 9 to generate the control signal according to the class of depressed actuating parts, and the equipment 13 started by this control signal as shown in drawing 7 . When the goods which it is going to manufacture are remote control of video, the video equipment operated with remote control is prepared for this equipment 13. Other configurations do not have the equipment (drawing 1) of the 1st example, and a change.
[0041] Moreover, as shown in drawing 8 , it is also possible to use the communication link information generating means 14 which replaced with the control signal generating means 9, and equipped the function of a control signal generating means with communication facility.
[0042] The method of actuation of an operator is the same as the case of the 1st example. If the carbon

button installation predetermined position of the front face of the remote control model 23 is pushed with the finger equipped with the location input means 1 The carbon button of the schedule arranged in the location where the contact condition detection means 6 was pushed is investigated, and it tells the operating state edit means 7. The operating state edit means 7 While ordering it sending out of the image data which displays the actuation condition of the corresponding carbon button to the location and the configuration description means 4 of the 2nd body, it orders so that a control signal when the corresponding carbon button is pushed to the control signal generating means 9 (communication link information generating means 14) may be generated.

[0043] When the pushed carbon button is for example, a play carbon button, the signal which starts a play from the control signal generating means 9 (communication link information generating means 14) is outputted, and video equipment 13 starts play actuation according to it.

[0044] Thus, with this equipment, actuation by that button grabbing is reproduced at the same time that condition is displayed on a screen, when the carbon button of goods is operated virtually. Therefore, an operator can realize the situation when operating a carbon button, can be based on the actual condition and can perform evaluation of goods.

[0045] (Example 3) The operability evaluation equipment of the 3rd example is constituted so that change of the location and configuration of the 1st body and the 2nd body may be memorized.

[0046] As this equipment is shown in drawing 9 , a change-of-state storage means 15 to memorize change of each body is connected to the location and the shape memory means 3 of the 1st body, and the location and shape memory means 4 of the 2nd body. Change of the condition of a body 1 and a body 2 is memorized for every fixed time interval and interference generating by the change-of-state storage means 15. Other configurations do not have the equipment (drawing 1) of the 1st example, and a change.

[0047] Migration of a body is memorized in the data format shown in drawing 10 (a) by the change-of-state storage means 15. Drawing 10 (b) is the explanatory view showing objective positional information. The location of the vector in three-dimension space is given with the sense (alpha, beta, gamma) of the vector indicated to be the location (x y, z) of the origin 101 of a vector by 102 as shown in drawing 10 (b). As the location of a body 1 is shown in drawing 10 (c), it is expressed with the vector fixed to the body 1, and the origin 103 of a vector and the sense 104 of a vector express the location of a body 1. If a body 1 moves like drawing 10 (c), the vector fixed to the body 1 will also move. Using the sense of this vector, as shown in drawing 10 (a), migration of a body 1 and a body 2 is memorized.

[0048] The method of actuation of an operator is the same as the case of the 1st example, and the data of the location and configuration description means of the 1st body and the data of the location and configuration description means of the 2nd body are memorized for ** by the change-of-state storage means 15 for every fixed time amount. Moreover, the contact condition detection means 6 issues the command which should memorize a condition for the change-of-state storage means 15 when interference of a body 1 and a body 2 is detected, and the change-of-state storage means 15 memorizes the condition at the time.

[0049] In the phase which a series of actuation ended, an operator can display on the direct presentation means 8 the data memorized by the change-of-state storage means 15 through each location and configuration description means. Therefore, an operator can reevaluate actuation, looking at the actuation that any number of times are the same without repeating the actuation performed once, after a series of actuation finishes.

[0050] Moreover, the correction of efficient actuation which utilized the actuation performed once is attained by correcting the data which responded to ** and were memorized by the change-of-state storage means 15.

[0051] (Example 4) The operability evaluation equipment of the 4th example is constituted so that the feeling which touched actuating parts by hand based on the signal from the contact condition detection means 6 may be reproduced in false.

[0052] This equipment is equipped with a tactile-sense generation means 16 to operate based on the signal from the contact condition detection means 6 as shown in drawing 11 . Other configurations do

not have the equipment (drawing 1) of the 1st example, and a change.
[0053] The tactile-sense generation means 16 has the tubing 121 containing air, as shown in drawing 12 (c), and if a signal is interlocked with from the contact condition detection means 6 and air is sent, when air goes into the room into which air goes like 122 and a curtain 123 swells, the feeling which pushed and touched the finger can be acquired. It is the perspective drawing where drawing 12 (a) saw a body 1 and the perspective drawing of the tactile-sense generation means 16, and drawing 12 (b) saw the body 1 from one at hand.
[0054] Thus, by experiencing in false the feeling which touched the hand with the tactile-sense generation means 16, evaluation of the operability based more on reality is attained.
[0055] (Example 5) Even if there is little solid figure data which the 1st body expresses, or solid figure data which the 2nd body expresses either, the operability evaluation equipment of the 5th example is constituted so that enlarging or contracting of one solid figure data can be carried out.
[0056] This equipment has the composition equipped with the 2nd zooming means 18 which carries out the zooming processing of the solid figure data which the 2nd body stored in the 1st zooming means 17 which carries out zooming processing of the solid figure data which the 1st body stored in the location and the configuration description means 3 of the 1st body as shown in drawing 13 expresses, and the location and the configuration description means 4 of the 2nd body expresses. Other configurations do not have the equipment (drawing 1) of the 1st example, and a change.
[0057] Drawing 14 is the object in which work of the enlarging-or-contracting means 17 and 18 was shown. If a body 1 is inserted in a finger like drawing 14 (a) and it is operated with a body 2, in the display means means 8, an image like drawing 14 (b) at first will appear. A body 1 is expanded with the 1st enlarging-or-contracting means to simulate actuation of a person to a slight degree with a large hand. Then, an image like drawing 14 (c) can be obtained by motion of the same hand.
[0058] This actuation is attained without being restricted to the magnitude of the actual remote control model 23 by establishing two zooming means, the 1st and the 2nd. That is, only with the 2nd zooming means, although restricted by the magnitude of an actual remote control model, the minimum of an interference location establishes the 1st zooming means, and a setup of an interference location of it is attained, without carrying out the magnitude limit of the actual remote control model by carrying out zooming of the 1st body. Thus, changing the magnitude of a hand, and the magnitude of a remote control model virtually, an interference location is set up freely and the test of operability is attained.
[0059] In addition, although the body 1 was expressed as a hand in this example, it is in ** that the same effectiveness is acquired even with the same expression as other examples.
[0060]
[Effect of the Invention] After it can confirm the feel and operability when operating the control unit to coincidence and further a series of actuation finishes with it, checking the condition that the control unit of the goods which it is going to develop with the operability evaluation equipment of this invention like [it is ****** and] was operated, by the three-dimension image from explanation of the above example, the actuation performed once can be utilized and efficient actuation can be evaluated.
[0061] Moreover, evaluation of the operability based more on reality is attained by experiencing in false the feeling which touched the hand with the tactile-sense generation means.
[0062] Moreover, evaluation of the operability which assumed various users with the zooming means is attained.
[0063] Moreover, since the simulation of the actuation when operating a control unit can be based and carried out to the actual condition, evaluation of exact operability operability is attained.

[Translation done.]

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TECHNICAL FIELD

[Industrial Application] This invention enables evaluation of the operability of goods by displaying virtually the situation when operating the control unit of goods especially about the evaluation equipment which displays the configuration of goods on a screen virtually, in order to evaluate about the design and function of goods in phases, such as a goods design and a prototype.

[Translation done.]

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EFFECT OF THE INVENTION

[Effect of the Invention] After it can confirm the feel and operability when operating the control unit to coincidence and further a series of actuation finishes with it, checking the condition that the control unit of the goods which it is going to develop with the operability evaluation equipment of this invention like [it is ****** and] was operated, by the three-dimension image from explanation of the above example, the actuation performed once can be utilized and efficient actuation can be evaluated.
[0061] Moreover, evaluation of the operability based more on reality is attained by experiencing in false the feeling which touched the hand with the tactile-sense generation means.
[0062] Moreover, evaluation of the operability which assumed various users with the zooming means is attained.
[0063] Moreover, since the simulation of the actuation when operating a control unit can be based and carried out to the actual condition, evaluation of exact operability operability is attained.

[Translation done.]

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PRIOR ART

[Description of the Prior Art] Correcting to a better form is performed widely, displaying the configuration of goods on a screen using the CAD system by the computer, and adding evaluation on the occasion of the design of goods etc., in recent years. By especially using 3D-Graphics recently, the appearance of the goods to create can be displayed in three dimensions, and the configuration can be enough examined in the phase before the prototype of goods through such a display.
[0003] This conventional CAD system is equipped with the input means 151, such as a keyboard and a mouse, a configuration storing means 152 to by_which the graphic data showing the appearance of goods are memorized, the configuration and the location description means 153 change those graphic data according to the input location of the input means 151, and a display means 154 display the appearance configuration of goods on a screen based on the changed coordinate data as shown in drawing 15 .
[0004] The configuration and the location description means 153 of this equipment will perform conversion (a parallel displacement and rotation) to the graphic data read from the configuration storing means 152 according to input data, if the data input of the "sense" and the "location" is carried out from the input means 151. And the changed data are supplied to the display means 154, and the display means 154 displays the appearance of goods based on the given graphic data.
[0005] Therefore, if a user moves the input means 151, according to the motion, the body on the display means 154 will change a location and the sense, and it will enable a user to check an objective appearance from the direction of arbitration through actuation of the input means 151.
[0006] The perspective view shows the situation when checking the appearance of goods to drawing 16 using the conventional CAD system.

[Translation done.]

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] However, it is only the appearance of goods which can be checked in the phase of a design, and it cannot make it display about the condition when operating the condition that goods are functioning, and actuating parts with conventional equipment. Therefore, since not only a design but a prototype must be redone when a problem is in operability as a result of this prototype although goods must actually be made as an experiment in order to evaluate the operability of goods, also in time, it will be forced economical very big futility.
[0008] This invention aims at offering the operability evaluation equipment by which the feeling of use and operability of goods can be evaluated, without solving such a conventional trouble and making the prototype of goods.

[Translation done.]

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OPERATION

[Function] Therefore, it is while the condition that the solid figure which the 2nd body expresses was operated will be displayed on a screen if the 1st body is contacted on the 2nd body, Since the change of state of each body is memorized, a user feels the feel when contacting the 1st body and 2nd body, and he can also perform correction of actuation, and reevaluation, without repeating the actuation which it not only can check the virtual condition at that time by looking in the pictures, but performed it once.
[0014] Moreover, evaluation of the operability based more on reality is attained by experiencing in false the feeling which touched the hand with the tactile-sense generation means.
[0015] Moreover, evaluation of the operability which assumed various users with the zooming means is attained.
[0016] Furthermore, if the 1st body is contacted on the 2nd body, a control signal will be outputted and the same actuation as the actuation which actually breaks out then will occur. Therefore, a user can evaluate goods by the condition of actually having been based.

[Translation done.]

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EXAMPLE

[Example]
(Example 1) The operability evaluation equipment in the 1st example of this invention For example, as shown in drawing 5 (a), a user equips the digiti manus with a location input means 11 to measure the three-dimension location. If the ******** goods model 23 (a location input means to measure a three-dimension location is embedded also to this model 23) is taken in its hand for the appearance of the goods which it is going to manufacture and the installation schedule part of the control unit of goods is operated in simulation with a finger As shown in drawing 5 (b), a virtual situation as if it was operating the control unit in actual goods with the finger can be displayed on a screen.
[0018] A location input means 1 to measure the three-dimension location of the 1st body equivalent to a finger as this operability evaluation equipment is shown in drawing 1 , A location input means 2 to input the three-dimension location of the 2nd body which is equivalent to the ******** model 23 in the appearance of goods, The location and a configuration description means 3 to create the graphic data showing the appearance configuration of the 1st body, The location and a configuration description means 4 to create the graphic data showing the appearance configuration of the 2nd body, A functional setting means 5 to set up the design location of the operating part installed in the 2nd body, the motion accompanying actuation, etc., It has a display means 8 to display a contact condition detection means 6 to detect the actuating parts of a schedule which check the contact situation of the 1st body and the 2nd body, and are installed in a contact location, an operating state edit means 7 to control the display showing the operating state of actuating parts, and the 1st body and the 2nd body.
[0019] As shown in drawing 2 (a), the location input means 1 of the 1st body is the magnetic sensor 12 which fixed to the applied part 11 to a finger, and measures the present location and present sense in three-dimension space by [of x of the field generated from the magnetic generator 10 used as the criteria of location detection, y, and the direction of z / each] carrying out intensity detection.
[0020] Moreover, the 2nd body measures the present location and present sense on which it is the ******** model 23 about the appearance of goods, and the magnetic field strength which a magnetic sensor 24 is embedded to the interior of a model 23 as the location input means 2, and is generated from the magnetic generator 10 is detected, and the model 23 is put, as shown in drawing 2 (b).
[0021] Drawing 3 is the explanatory view of a magnetic sensor. In drawing 3 , 31 is a magnetic field generating coil, 32 is a receiver coil, and it consists of three coils which went direct, respectively. A magnetic field is generated sequentially from three dispatch coils of 31. If a receiver coil like 32 is placed into this magnetic field, a current will occur in each of a receiver coil and the three-dimension-location of a receiver coil 32 will be detected from the magnitude of this current. The dispatch coil 31 is in the interior of the magnetic generator 10, and a receiver coil 32 is in the interior of sensors 12 and 24.
[0022] When an operator operates goods in simulation, as shown in drawing 4 (a), the applied part 11 to which the magnetic sensor was fixed is inserted in a finger, and the model 23 with which the magnetic sensor was embedded is held by hand. If it carries out like this, a finger, and the location and sense of a model 23 will be measured by sensors 12 and 24, and measurement data will be sent to the location and the configuration description means 3 of the 1st body, and the location and configuration description

means 4 of the 2nd body.
[0023] The location and the configuration description means 3 and 4 of the 1st body and the 2nd body hold the coordinate data (initial value) of the top-most vertices of the field which constitutes the appearance configuration of each body as graphic data.
[0024] Moreover, the functional setting means 5 holds the data about a configuration when the location of the number of actuating parts, such as the data about the function set up by the operator, i.e., a manual operation button, and a slider, the field of the goods which arrange actuating parts, the configuration of actuating parts, and the actuating parts on a goods side, and actuating parts are functioning etc., and supplies these data to the location and the configuration description means 4 of the 2nd body.
[0025] If measurement data is inputted from the 1st body location input means 1, the location and the configuration description means 3 of the 1st body will perform parallel translation according to the location and sense of the 1st body which were measured, and rotational data processing to the graphic data currently held, and will send the data after processing to the display means 8.
[0026] Moreover, the location and the configuration description means 4 of the 2nd body set the data inputted from the graphic data currently held and the functional setting means 5, and constitutes the graphic data of the goods with which actuating parts have been arranged, and these graphic data are received. Data processing according to the observation data inputted from the location input means 2 of the 2nd body is performed, and the graphic data showing the condition that actuating parts are not functioning among the data after processing are first sent to the display means 8.
[0027] Therefore, the simulation finger corresponding to the 1st body and the goods corresponding to the 2nd body with which actuating parts were installed are displayed, and as shown in drawing 4 (b), these displays will move a screen top to the display screen like it, if a user moves a finger or moves a model.
[0028] In addition, by drawing 4 , remote control of a videocassette recorder is taken up for an example, and signs that the carbon button with the various functions specified to the remote control on a screen (the 2nd body) with the functional setting means 5 is arranged are shown.
[0029] The carbon button on this remote control can be operated with the 1st body. When performing this, as shown in drawing 5 (a), the surface carbon button installation predetermined position of the model 23 of the 2nd body is pushed with the finger equipped with the location input means 1 (11) so that the 1st body may lap with the carbon button on the 2nd body on a display screen.
[0030] At this time, the contact condition detection means 6 investigates the carbon button which detects the location where the distance of the field in the graphic data of the 1st body and the field in the graphic data of the 2nd body is calculated, and that distance becomes 0, and with which a field laps as an interference location, and is located in an interference location, and tells the operating state edit means 7.

[0031] Drawing 6 is drawing having shown the actuation which detects an interference location. In case interference of two bodies is checked, a body is disassembled into a field and the existence of interference is checked for every field. By drawing 6 , 61 shows a body 1, 62 shows the body 2, and all are constituted from a rectangular parallelepiped by six fields. First, as shown in drawing 6 , it is confirmed whether all the fields that constitute one and the body 1 of the field which constitutes a body 2 overlap. If whether it is which field overlap, it will be considered that two bodies are those in which it has interfered.
[0032] If it does not overlap, the check same about the next field of a body 2 is carried out. Thus, if none of the fields of a body 2 and all the fields of a body 1 overlaps, it shall not have interfered in two bodies.

[0033] An operating-state edit means 7 to by_which such an interference check received the information on a carbon button are located in an interference location orders sending out of the image data which displays the actuation condition of the corresponding carbon button to the location and the configuration description means 4 of the 2nd body, and the location and the configuration description means 4 of the 2nd body sends out the image data which shows the condition that the operated carbon button was depressed to a display means 8.

[0034] Consequently, as shown in drawing 5 (b), the situation that the false finger is depressing the carbon button of remote control is displayed on the screen of the display means 8.
[0035] In addition, the actuation condition of actuating parts can carry out highlighting of the corresponding actuating parts in a color brighter than other components, or can also express the explanatory note explaining actuation by making it appear in a screen.
[0036] By such display, a user can check which carbon button of remote control he has pushed.
[0037] They can be immediately changed by performing such actuation, and changing description of the actuating parts given to the functional setting means 5, when it is judged that a location, a configuration, etc. of a carbon button which have been arranged on the 2nd body are unsuitable. An operator can change a location, a configuration, etc. of a carbon button any number of times until the operability to which can be convinced is acquired.
[0038] Moreover, as long as the 1st body is a member which causes a new motion of the member of another side in the condition of having contacted, it may be objects other than a finger.
[0039] (Example 2) The operability evaluation equipment of the 2nd example is constituted so that the actuation accompanying actuation may actually occur, while an actuation condition is displayed on a screen, when the operating part of goods is operated virtually.
[0040] This equipment is equipped with a control signal generating means 9 to generate the control signal according to the class of depressed actuating parts, and the equipment 13 started by this control signal as shown in drawing 7 . When the goods which it is going to manufacture are remote control of video, the video equipment operated with remote control is prepared for this equipment 13. Other configurations do not have the equipment (drawing 1) of the 1st example, and a change.
[0041] Moreover, as shown in drawing 8 , it is also possible to use the communication link information generating means 14 which replaced with the control signal generating means 9, and equipped the function of a control signal generating means with communication facility.
[0042] The method of actuation of an operator is the same as the case of the 1st example. If the carbon button installation predetermined position of the front face of the remote control model 23 is pushed with the finger equipped with the location input means 1 The carbon button of the schedule arranged in the location where the contact condition detection means 6 was pushed is investigated, and it tells the operating state edit means 7. The operating state edit means 7 While ordering it sending out of the image data which displays the actuation condition of the corresponding carbon button to the location and the configuration description means 4 of the 2nd body, it orders so that a control signal when the corresponding carbon button is pushed to the control signal generating means 9 (communication link information generating means 14) may be generated.
[0043] When the pushed carbon button is for example, a play carbon button, the signal which starts a play from the control signal generating means 9 (communication link information generating means 14) is outputted, and video equipment 13 starts play actuation according to it.
[0044] Thus, with this equipment, actuation by that button grabbing is reproduced at the same time that condition is displayed on a screen, when the carbon button of goods is operated virtually. Therefore, an operator can realize the situation when operating a carbon button, can be based on the actual condition and can perform evaluation of goods.
[0045] (Example 3) The operability evaluation equipment of the 3rd example is constituted so that change of the location and configuration of the 1st body and the 2nd body may be memorized.
[0046] As this equipment is shown in drawing 9 , a change-of-state storage means 15 to memorize change of each body is connected to the location and the shape memory means 3 of the 1st body, and the location and shape memory means 4 of the 2nd body. Change of the condition of a body 1 and a body 2 is memorized for every fixed time interval and interference generating by the change-of-state storage means 15. Other configurations do not have the equipment (drawing 1) of the 1st example, and a change.
[0047] Migration of a body is memorized in the data format shown in drawing 10 (a) by the change-of-state storage means 15. Drawing 10 (b) is the explanatory view showing objective positional information. The location of the vector in three-dimension space is given with the sense (alpha, beta,

gamma) of the vector indicated to be the location (x y, z) of the origin 101 of a vector by 102 as shown in drawing 10 (b). As the location of a body 1 is shown in drawing 10 (c), it is expressed with the vector fixed to the body 1, and the origin 103 of a vector and the sense 104 of a vector express the location of a body 1. If a body 1 moves like drawing 10 (c), the vector fixed to the body 1 will also move. Using the sense of this vector, as shown in drawing 10 (a), migration of a body 1 and a body 2 is memorized.
[0048] The method of actuation of an operator is the same as the case of the 1st example, and the data of the location and configuration description means of the 1st body and the data of the location and configuration description means of the 2nd body are memorized for ** by the change-of-state storage means 15 for every fixed time amount. Moreover, the contact condition detection means 6 issues the command which should memorize a condition for the change-of-state storage means 15 when interference of a body 1 and a body 2 is detected, and the change-of-state storage means 15 memorizes the condition at the time.
[0049] In the phase which a series of actuation ended, an operator can display on the direct presentation means 8 the data memorized by the change-of-state storage means 15 through each location and configuration description means. Therefore, an operator can reevaluate actuation, looking at the actuation that any number of times are the same without repeating the actuation performed once, after a series of actuation finishes.
[0050] Moreover, the correction of efficient actuation which utilized the actuation performed once is attained by correcting the data which responded to ** and were memorized by the change-of-state storage means 15.
[0051] (Example 4) The operability evaluation equipment of the 4th example is constituted so that the feeling which touched actuating parts by hand based on the signal from the contact condition detection means 6 may be reproduced in false.
[0052] This equipment is equipped with a tactile-sense generation means 16 to operate based on the signal from the contact condition detection means 6 as shown in drawing 11 . Other configurations do not have the equipment (drawing 1) of the 1st example, and a change.
[0053] The tactile-sense generation means 16 has the tubing 121 containing air, as shown in drawing 12 (c), and if a signal is interlocked with from the contact condition detection means 6 and air is sent, when air goes into the room into which air goes like 122 and a curtain 123 swells, the feeling which pushed and touched the finger can be acquired. It is the perspective drawing where drawing 12 (a) saw a body 1 and the perspective drawing of the tactile-sense generation means 16, and drawing 12 (b) saw the body 1 from one at hand.
[0054] Thus, by experiencing in false the feeling which touched the hand with the tactile-sense generation means 16, evaluation of the operability based more on reality is attained.
[0055] (Example 5) Even if there is little solid figure data which the 1st body expresses, or solid figure data which the 2nd body expresses either, the operability evaluation equipment of the 5th example is constituted so that enlarging or contracting of one solid figure data can be carried out.
[0056] This equipment has the composition equipped with the 2nd zooming means 18 which carries out the zooming processing of the solid figure data which the 2nd body stored in the 1st zooming means 17 which carries out zooming processing of the solid figure data which the 1st body stored in the location and the configuration description means 3 of the 1st body as shown in drawing 13 expresses, and the location and the configuration description means 4 of the 2nd body expresses. Other configurations do not have the equipment (drawing 1) of the 1st example, and a change.
[0057] Drawing 14 is the object in which work of the enlarging-or-contracting means 17 and 18 was shown. If a body 1 is inserted in a finger like drawing 14 (a) and it is operated with a body 2, in the display means means 8, an image like drawing 14 (b) at first will appear. A body 1 is expanded with the 1st enlarging-or-contracting means to simulate actuation of a person to a slight degree with a large hand. Then, an image like drawing 14 (c) can be obtained by motion of the same hand.
[0058] This actuation is attained without being restricted to the magnitude of the actual remote control model 23 by establishing two zooming means, the 1st and the 2nd. That is, only with the 2nd zooming means, although restricted by the magnitude of an actual remote control model, the minimum of an

interference location establishes the 1st zooming means, and a setup of an interference location of it is attained, without carrying out the magnitude limit of the actual remote control model by carrying out zooming of the 1st body. Thus, changing the magnitude of a hand, and the magnitude of a remote control model virtually, an interference location is set up freely and the test of operability is attained. [0059] In addition, although the body 1 was expressed as a hand in this example, it is in ** that the same effectiveness is acquired even with the same expression as other examples.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The block diagram showing the configuration of the operability evaluation equipment in the 1st example of this invention
[Drawing 2] The 1st explanatory view of the location input means in the operability evaluation equipment of an example
[Drawing 3] The 2nd explanatory view of the location input means in the operability evaluation equipment of an example
[Drawing 4] The goods operating instructions and the display screen Fig. in equipment of an example
[Drawing 5] Actuation and a screen Fig. in case the equipment of an example estimates the operability of goods
[Drawing 6] The explanatory view of the contact condition detection means 6 in an example
[Drawing 7] The 1st block diagram showing the configuration of the operability evaluation equipment in the 2nd example of this invention
[Drawing 8] The 2nd block diagram showing the configuration of the operability evaluation equipment in the 2nd example of this invention
[Drawing 9] The block diagram showing the configuration of the operability evaluation equipment in the 3rd example of this invention
[Drawing 10] The explanatory view of the change-of-state storage means 15 in the 3rd example of operation
[Drawing 11] The block diagram showing the configuration of the operability evaluation equipment in the 4th example of this invention
[Drawing 12] The conceptual diagram showing the configuration of the tactile-sense generation means 16 in the 4th example
[Drawing 13] The block diagram showing the configuration of the operability evaluation equipment in the 5th example of this invention
[Drawing 14] The goods operating instructions and the display screen Fig. 5 in an example
[Drawing 15] The block diagram showing the conventional CAD structure of a system
[Drawing 16] The external view of the conventional system
[Description of Notations]
1 Location Input Means of 1st Body
2 Location Input Means of 2nd Body
3 Location and Configuration Description Means of 1st Body
4 Location and Configuration Description Means of 2nd Body
5 Functional Setting Means
6 Contact Condition Detection Means
7 Operating State Edit Means
8 Display Means
9 Control Signal Generating Means

10 Magnetic Generator
11 Applied Part
12 Sensor
13 Video Equipment
14 Communication Link Information Generating Means
15 Change-of-State Storage Means
16 Tactile-Sense Generation Means
17 1st Zooming Means
18 2nd Zooming Means
31 Dispatch Coil
32 Receiver Coil
23 Model
61 Body 1
62 Body 2
151 Input Means
152 Configuration Storing Means
153 Configuration and Location Description Means
154 Display Means

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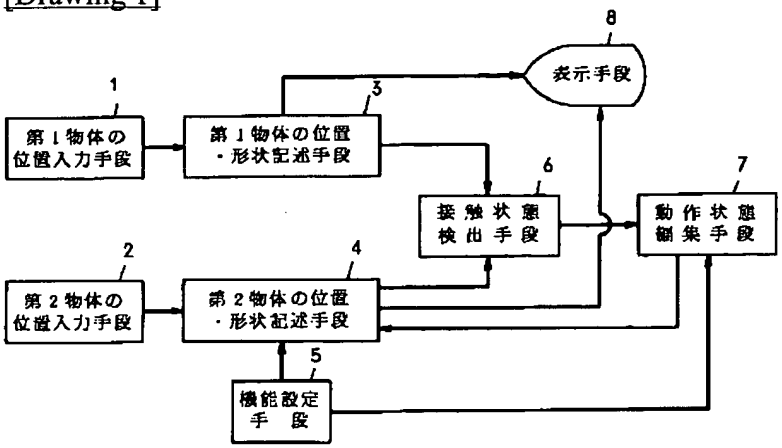
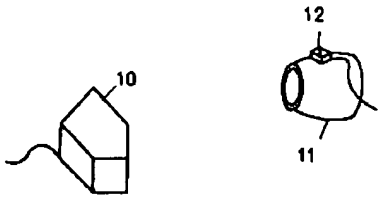
DRAWINGS

[Drawing 1]



[Drawing 2]

(a)



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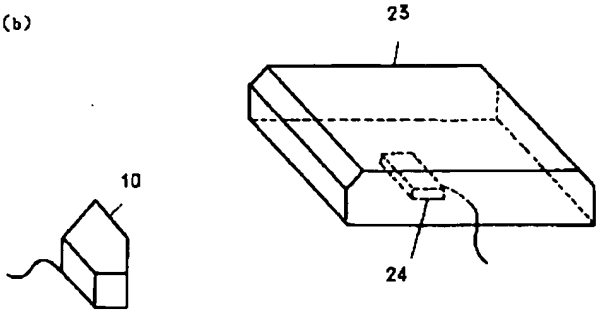
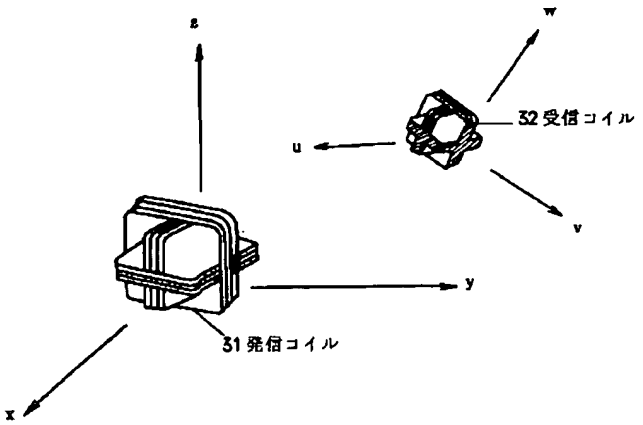
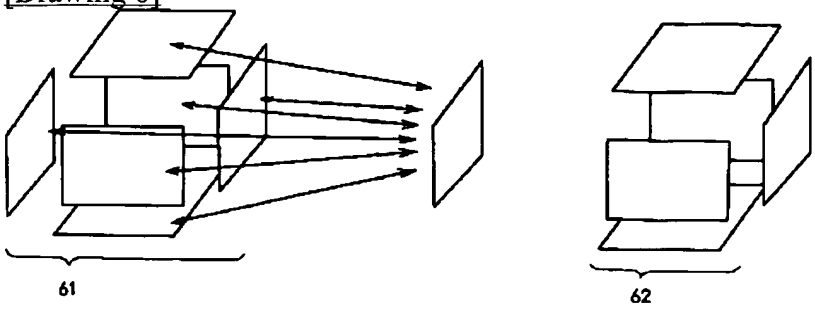


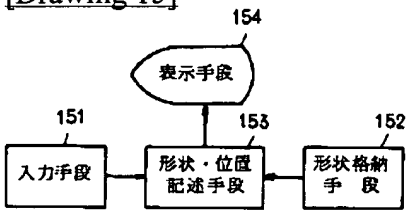
[Drawing 3]



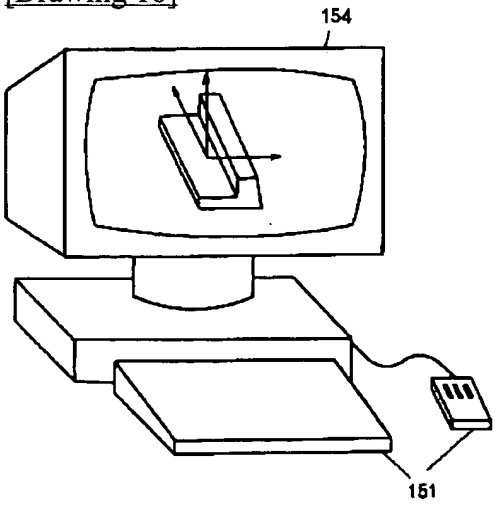
[Drawing 6]



[Drawing 15]

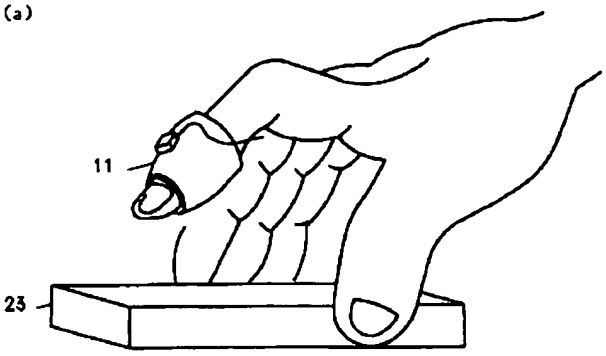


[Drawing 16]



[Drawing 4]

(a)



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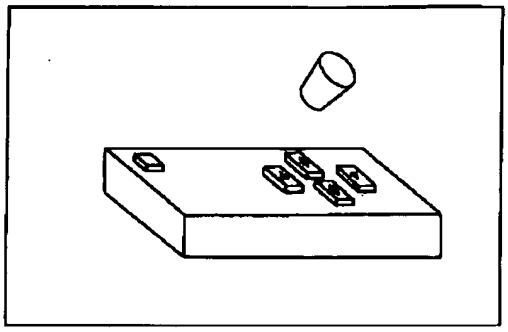
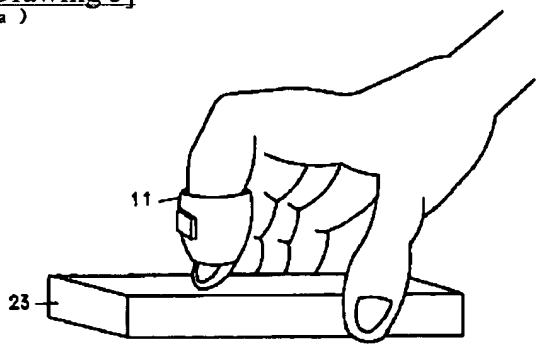


[Drawing 5]

(a)



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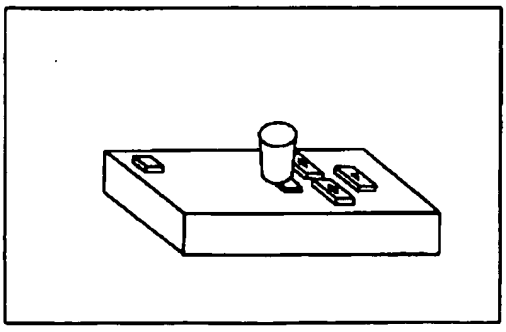
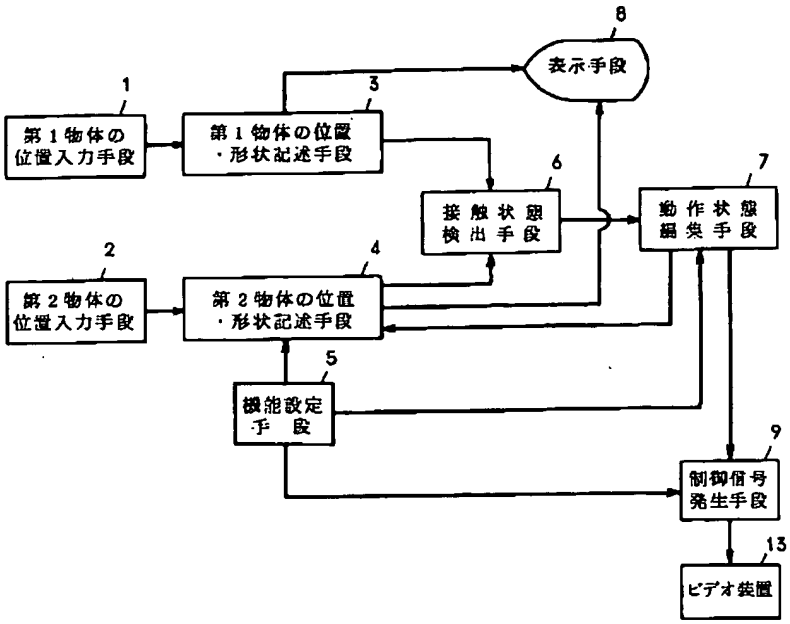
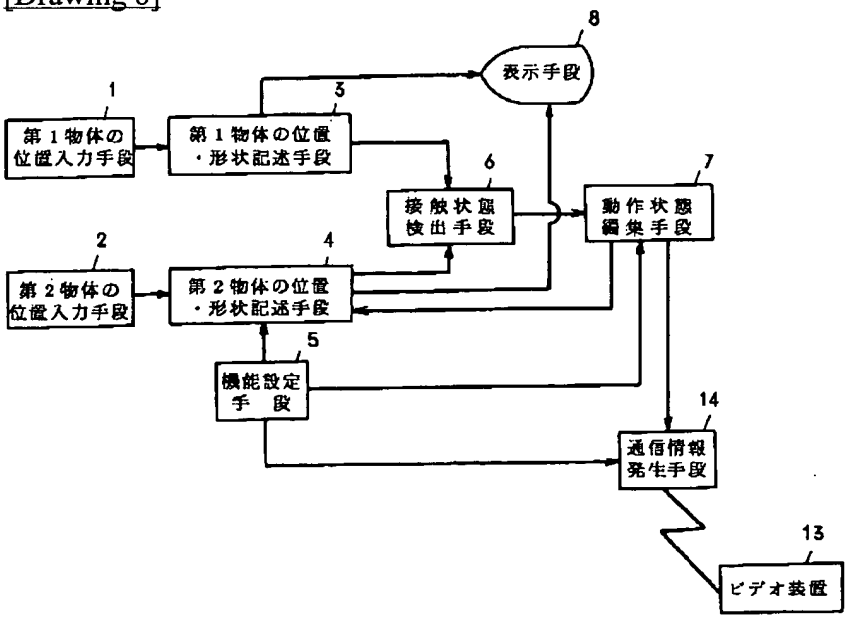


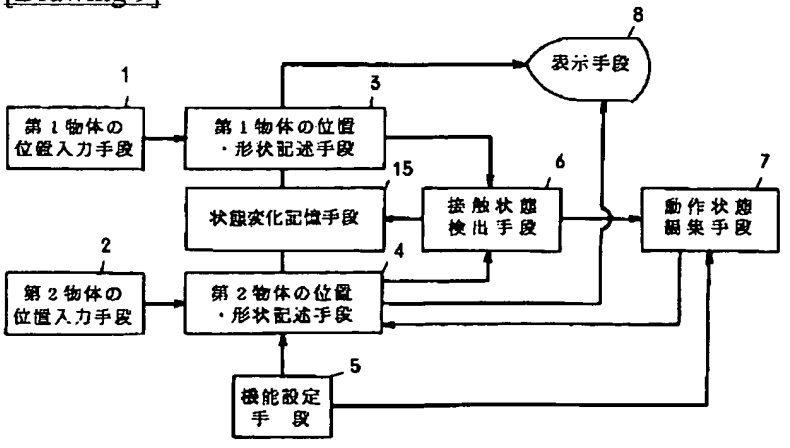
[Drawing 7]



[Drawing 8]



[Drawing 9]

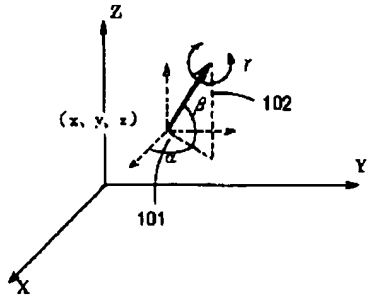


[Drawing 10]

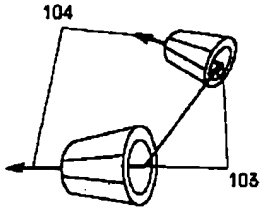
(a)

物体１の動き （x、y、z、α、β、γ）
物体２の動き （x、y、z、α、β、γ）
物体１の動き （x、y、z、α、β、γ）
...
...
...

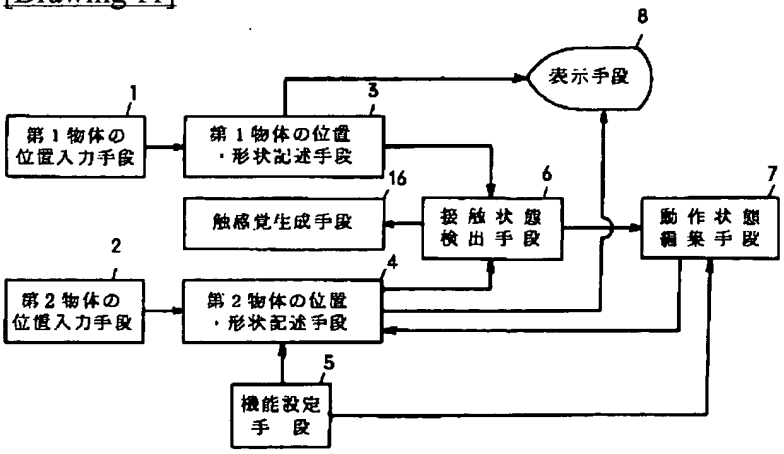
(b)



(c)

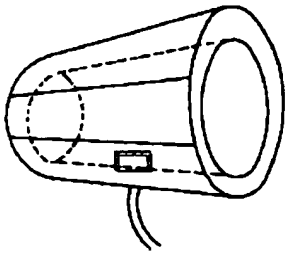


[Drawing 11]

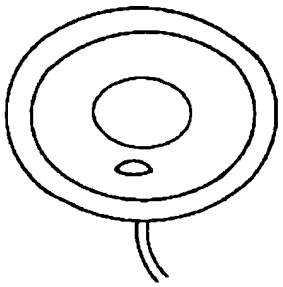


[Drawing 12]

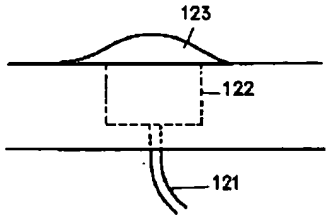
(a)



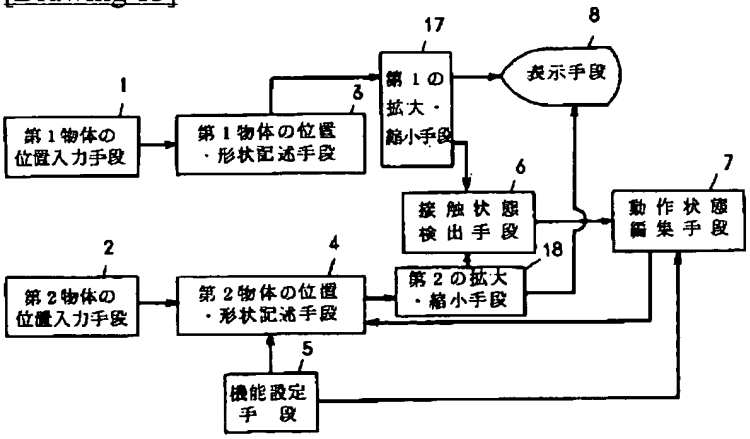
(b)



(c)

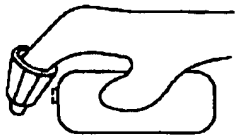


[Drawing 13]

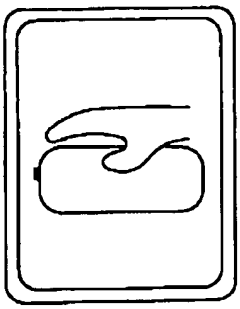


[Drawing 14]

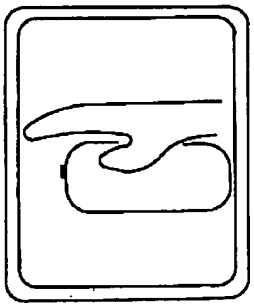
(a)



(b)



(c)



[Translation done.]